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Supplementary Material to

Phenotypic evaluation of natural and industrial *Saccharomyces* yeasts for different traits desirable in industrial bioethanol production

Vaskar Mukherjee[1,3#], Jan Steensels[2#], Bart Lievens[1], Ilse Van de Voorde[3], Alex Verplaetse[3], Guido Aerts[3], Kris A. Willems[1], Johan M. Thevelein[4], Kevin J. Verstrepen[2] and Stefan Ruyters[1*]

[1] KU Leuven, Laboratory for Process Microbial Ecology and Bioinspirational Management, Cluster for Bioengineering Technology (CBeT), Department of Microbial and Molecular Systems (M2S), Campus De Nayer, Fortsesteenweg 30A, B-2860 Sint-Katelijne-Waver, Belgium

[2] KU Leuven, Laboratory for Genetics and Genomics & VIB Laboratory for Systems Biology, Centre of Microbial and Plant Genetics (CMPG), Department of Microbial and Molecular Systems (M2S), Gaston Geenslaan 1, B-3001 Leuven, Belgium

[3] KU Leuven, Laboratory of Enzyme, Fermentation, and Brewing Technology, Cluster for Bioengineering Technology (CBeT), Department of Microbial and Molecular Systems (M2S), Campus KaHo Sint-Lieven, Gebroeders De Smetstraat 1, B-9000 Ghent, Belgium

[4] KU Leuven, Laboratory of Molecular Cell Biology, Institute of Botany and Microbiology, and VIB Department of Molecular Microbiology, Kasteelpark Arenberg 31, B-3001 Leuven,Belgium

*corresponding author:

stefan.ruyters@kuleuven.be

Fortsesteenweg 30A, B-2860 Sint-Katelijne-Waver, Belgium

Tel +32 15 30 55 97

Fax +32 15 30 55 99

[#]These authors contributed equally

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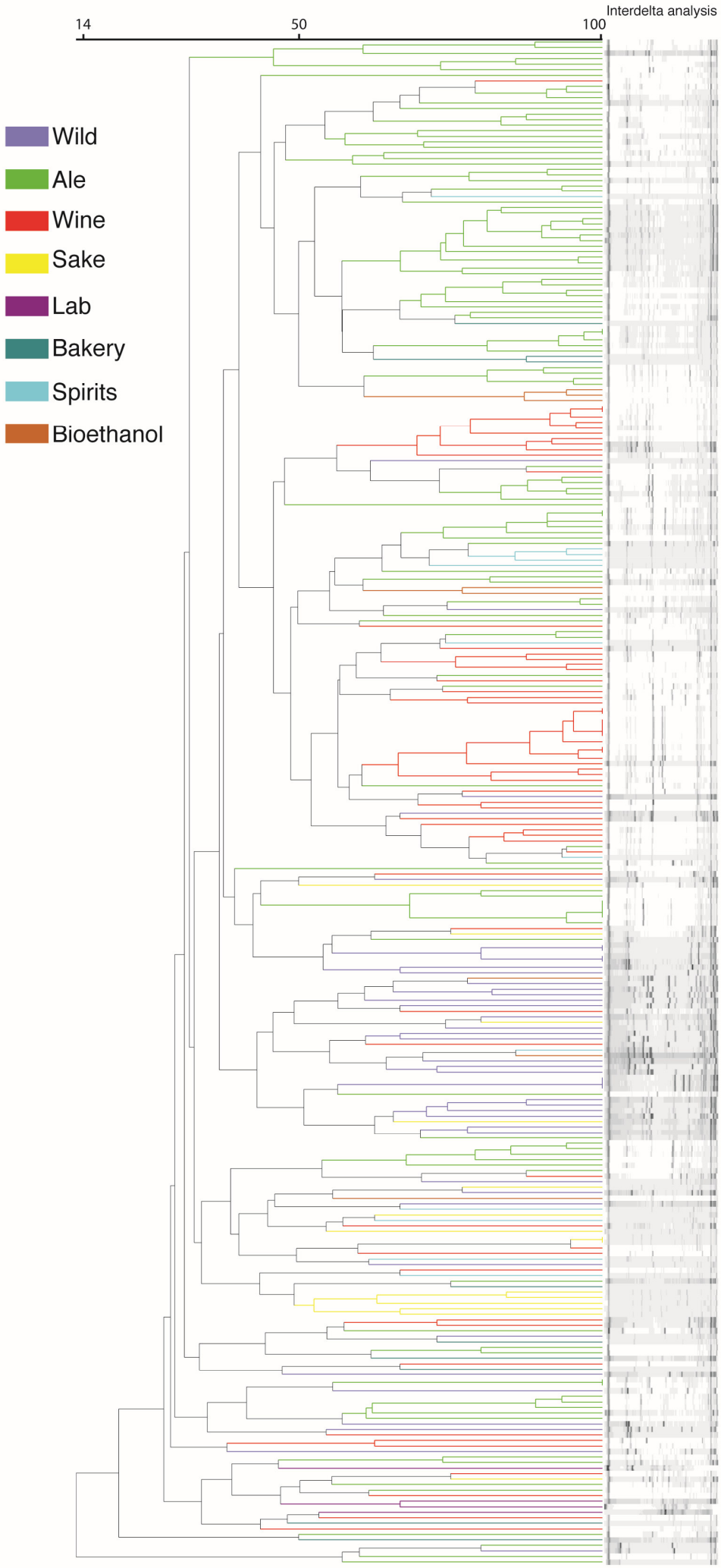

Figure S1: Genotypic clustering of the *Saccharomyces cerevisiae* strains investigated in this study. Strains from different origins are marked in different colors (see Figure for color legend). Fingerprints for each strain are given.

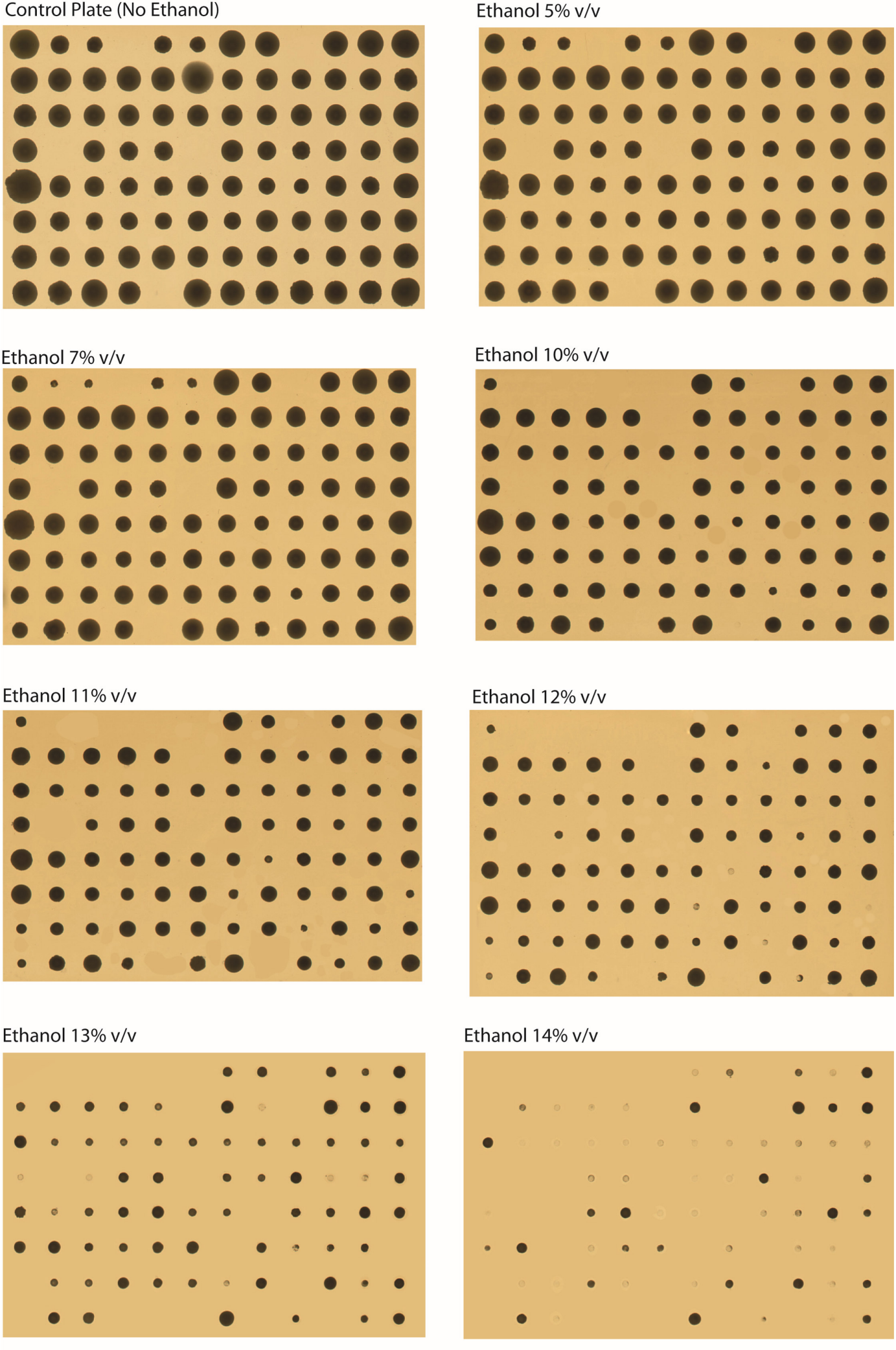

Figure S2: Phenotypic diversity of *Saccharomyces* strains on increasing concentrations of ethanol; representative images of the plates

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Supplementary Table S1: Overview of the phenotypic profiling parameters and corresponding test concentrations

Osmotolerance (Tokuoka 1993; Ok and Hashinaga 1997; Tedrick et al. 2004; Dudley et al. 2005; Osho 2005; Watanabe et al. 2010)	**Glucose % w/v**	**2**	**40**	**46**	**48**	**50**	**55**	**60**	**70**
	Fructose % w/v	**2**	**40**	**46**	**48**	**50**	**55**	**60**	**70**
	Sorbitol % w/v	**10**	**30**	**40**	**44**	**46**	**48**	**50**	**55**
Ethanol Tolerance (Alper et al. 2006; Yoshikawa et al. 2009; Tikka et al. 2013)	**Ethanol % v/v**	**5**	**7**	**10**	**11**	**12**	**13**	**14**	**15**
Halotolerance (Lahav et al. 2002; Dudley et al. 2005; Yoshikawa et al. 2009)	**NaCl (mM)**	**500**	**1000**	**1500**	**2000**	**2250**	**2500**	**2750**	**3000**
	KCL (mM)	**1000**	**1500**	**2000**	**2500**	**2750**	**3000**	**3500**	**4000**
	LiCl (mM)	**10**	**50**	**100**	**200**	**300**	**400**	**500**	**600**
Metal Tolerance (Vadkertiová and Sláviková 2006)	**Zn (mM)**	**1**	**2**	**3.5**	**5**	**6**	**7**	**8**	**10**
	Cu (mM)	**0.1**	**0.2**	**0.3**	**0.4**	**0.5**	**1**	**1.5**	**2**
	Cd (mM)	**0.25**	**0.5**	**1**	**1.5**	**2**	**2.5**	**3**	**3.5**
Furan Derivative (Almeida et al. 2007; Wikandari et al. 2010;)	**HMF (g/L)**	**2**	**3**	**4**	**5**	**6**	**7**		
Thermotolerance (Ballesteros et al. 1991)	**Incubation Temperature (°C)**	**24**	**30**	**37**	**39**	**41**			

Supplementary Table S2: Percentage of strains growing at reference conditions and the corresponding coefficient of variations.

Reference conditions	Glucose 48%	Fructose 48%	Sorbitol 44%	NaCl 1000 mM	KCl 1500 mM	LiCl 50 mM	ET 12%	T 39°C	HMF 3g/L	$ZnCl_2$ 5mM	$CdSO_4$ 0.5mM	$CuSO_4$ 0.1mM
% of strain growing	52	56	51	58	70	47	55	50	50	40	40	32
Coefficient of Variation	1.12	1.06	1.10	1.14	0.84	1.77	1.10	1.37	1.44	1.73	1.74	1.74

Supplementary Table S3: Relative growth of all strains on all parameters (see Table S1), except for parameters at which no growth of any of the strains was recorded.

See xlsx database in the other supplementary file

Supplementary Table S4A: Pairwise comparisons of different species using Wilcoxon rank sum test with holms correction of p value

Comparing species														
	1	2	3			1	2	3			1	2	3	
2	0.0022	-	-	Glucose	2	0.0356	-	-	Fructose	2	0.00045	-	-	Sorbitol
3	0.8167	0.1624	-		3	0.7806	0.7806	-		3	0.36778	0.01855	-	
4	9.70E-06	9.80E-08	0.0041		4	1.10E-05	5.90E-07	0.0018		4	4.70E-07	4.50E-10	0.0335	
	1	2	3			1	2	3			1	2	3	
2	0.02	-	-	NaCl	2	0.0058	-	-	KCl	2	0.032	-	-	LiCl
3	0.47	0.97	-		3	0.1415	0.0078	-		3	0.891	0.491	-	
4	0.97	0.64	0.97		4	5.40E-05	2.30E-06	0.564		4	0.119	0.856	0.792	
	1	2	3			1	2	3			1	2	3	
2	0.01763	-	-	Ethanol	2	1.00E-08	-	-	Temp	2	0.51	-	-	HMF
3	0.19414	0.01763	-		3	0.56509	0.00086	-		3	1	1	-	
4	2.00E-07	0.01763	0.00036		4	1.20E-05	0.24307	0.11076		4	5.00E-09	6.30E-10	3.90E-05	
	1	2	3			1	2	3			1	2	3	
2	1	-	-	Zn	2	3.50E-13	-	-	Cd	2	0.0061	-	-	Cu
3	0.328	0.372	-		3	0.7847	0.0007	-		3	0.0223	7.70E-05	-	
4	0.016	0.149	1		4	0.9212	8.70E-09	0.9212		4	0.0024	0.9666	4.10E-05	
1 ***S. cerevisiae*****; 2** ***S. paradoxus*****; 3** ***S. bayanus*****; 4** ***S. pastorianus***														

Supplementary Table S4B: Pairwise comparisons of different origins of *S. cerevisiae* strains using Wilcoxon rank sum test with holms correction of p value

	1	2	3	4	5	6			1	2	3	4	5	6	
2	1	-	-	-	-	-	Glucose	2	1	-	-	-	-	-	Fructose
3	2.10E-05	0.067	-	-	-	-		3	0.00126	0.04992	-	-	-	-	
4	0.933	1	0.067	-	-	-		4	1	1	0.01883	-	-	-	
5	4.90E-09	0.609	0.205	0.266	-	-		5	0.00351	1	0.27182	0.24751	-	-	
6	2.10E-06	0.146	1	0.036	1	-		6	0.00071	0.27182	1	0.01151	0.86798	-	
7	2.40E-09	0.203	1	0.073	0.609	1		7	1.30E-07	0.14604	1	0.00782	0.06658	1	
	1	2	3	4	5	6			1	2	3	4	5	6	
2	1	-	-	-	-	-	Sorbitol	2	0.617	-	-	-	-	-	NaCl
3	0.00021	0.01479	-	-	-	-		3	1	1	-	-	-	-	
4	1	1	0.03875	-	-	-		4	0.025	1	0.568	-	-	-	
5	0.15443	1	0.01632	1	-	-		5	0.556	1	1	0.138	-	-	
6	0.00021	0.01217	1	0.03717	0.07408	-		6	1	0.253	1	0.042	1	-	
7	4.50E-06	0.2047	1	0.12522	0.03717	1		7	1	1	1	0.188	1	1	
	1	2	3	4	5	6			1	2	3	4	5	6	
2	1	-	-	-	-	-	KCl	2	0.19	-	-	-	-	-	LiCl
3	0.1839	1	-	-	-	-		3	1	1	-	-	-	-	
4	0.3797	0.6342	0.0803	-	-	-		4	0.02	1	0.68	-	-	-	
5	0.2473	1	0.2128	1	-	-		5	0.13	1	1	0.37	-	-	
6	0.1379	1	1	0.0501	0.1191	-		6	1	1	1	0.15	1	-	
7	7.30E-05	1	1	0.0068	0.0016	1		7	0.68	1	1	1	1	1	
	1	2	3	4	5	6			1	2	3	4	5	6	
2	0.0055	-	-	-	-	-	Ethanol	2	0.076	-	-	-	-	-	Temp
3	2.80E-06	0.0018	-	-	-	-		3	6.10E-05	0.449	-	-	-	-	
4	3.00E-	1	0.0331	-	-	-		4	0.065	1	1	-	-	-	

	05														
5	2.00E-16	1	0.0018	1	-	-		5	2.10E-12	1	1	1	-	-	
6	3.00E-05	1	0.006	1	1	-		6	8.70E-07	1	1	0.308	0.185	-	
7	4.30E-06	1	0.0428	1	1	1		7	5.20E-09	1	1	1	1	1	
	1	2	3	4	5	6			1	2	3	4	5	6	
2	1	-	-	-	-	-	HMF	2	0.99	-	-	-	-	-	Zn
3	0.00405	1	-	-	-	-		3	1	1	-	-	-	-	
4	1	1	0.05708	-	-	-		4	1	1	1	-	-	-	
5	2.00E-16	0.08585	1	0.00015	-	-		5	0.5	1	1	1	-	-	
6	0.001	1	1	0.05419	0.58708	-		6	1	1	1	1	1	-	
7	2.50E-11	0.31376	1	0.00258	1	1		7	1	0.52	1	1	0.99	1	
	1	2	3	4	5	6			1	2	3	4	5	6	
2	1	-	-	-	-	-	Cd	2	0.26188	-	-	-	-	-	Cu
3	0.709	1	-	-	-	-		3	1	0.32931	-	-	-	-	
4	1	0.362	0.221	-	-	-		4	1	0.55665	1	-	-	-	
5	1	1	1	0.362	-	-		5	8.10E-08	1	0.05756	0.05392	-	-	
6	1	1	1	1	1	-		6	0.66939	0.03888	1	0.32931	0.00107	-	
7	0.043	1	1	0.092	1	1		7	1	0.25744	1	1	0.00033	1	

1= Ale; 2= Bakery; 3= Biofuel; 4= Sake; 5= Wine; 6= Spirit; 7= Wild

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